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Conference Paper

Knowledge economy policy in Polish regions

52nd Congress of the European Regional Science Association: "Regions in Motion - Breaking the Path", 21-25 August 2012, Bratislava, Slovakia

Provided in Cooperation with:
European Regional Science Association (ERSA)

Suggested Citation: Woźniak, Dariusz; Sokołowska-Woźniak, Justyna (2012) : Knowledge economy policy in Polish regions, 52nd Congress of the European Regional Science Association: "Regions in Motion - Breaking the Path", 21-25 August 2012, Bratislava, Slovakia, European Regional Science Association (ERSA), Louvain-la-Neuve

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DRAFT PAPER. PLEASE DO NOT QUOTE

Justyna Sokołowska - Woźniak, Dariusz Woźniak
Knowledge economy policy in Polish regions

The aim of this paper is twofold. The first is to examine the level of development of knowledge economy in Polish regions (Voivodeships). In order to assess the advances in building the knowledge economy in region, the composite indicator for years 2003-2008 is constructed. The second purpose is to analyse the regional authorities' policies directed towards supporting the pillars underlying the knowledge economy

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Knowledge economy policy in Polish regions

Introduction

Although knowledge was an important factor for socio-economic development at any time during the development of human civilization, the idea of knowledge-based economy has become especially popular in the scientific community and the idea of the building has gained recognition among policy makers since the 90. of the previous century. This is in part related to the flowering of research on long-term factors of economic growth, beginning in the late 80s with the works of P.M. Romer and R.E. Lucas[3], now belonging to the endogenous growth theory. The representatives of this trend, treat knowledge as an endogenous factor, based on its impact on economic development through mechanisms such as investment in human capital, skills, human capital, research and development or public infrastructure.

One major problem, which is associated with the concept of knowledge-based economy is the level of spatial differentiation of socio-economic development. The question, whether the development of ICT and the activities of multinational corporations, promoting the spread of knowledge, leads to the end of economic geography (as distance does not matter), whether the development is local (because knowledge does not spread globally, and innovation, seen as a process resulting from institutional systems and social customs, are strongly associated

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[3]Lucas R. E., *On the Mechanics of Economic Development*, Journal of Monetary Economics, 22, 1 (July), 3-42, 1988., Romer P.M., *Endogenous Technological Change*, Journal of Political Economy, 98,5 (October), Part II, S71–S102. Romer P.M., *Increasing Returns and Long-Run Growth*, Journal of Political Economy, 94, 5 (October), Part II, 1002-1037, 1986.

with the location) is still valid and is the subject of many studies. In recent times there has been renewed interest in the region as a place of organization of economic life and the subject of economic policy. Regionalization, defined as economic activity dependent on resource-specific location has become a popular trend[4].

As the result of the claim that production, absorption and dissemination of knowledge is the key factor of competitiveness and development on macro-, mezo- and micro-level, public policies supporting science, technology and innovation are very numerous in many countries. The necessity of a government involvement in promoting the development of the knowledge economy is justified by the market failure such as: knowledge as a public good, high external benefits associated with the formation and spread of knowledge, the high risks associated with conducting research and development activities. It is also recognized that the state should provide the infrastructure, which will support the net of relationship and collaboration between research units and business[5]. The program of the Lisbon European Council (Lisbon Strategy), which aim was to create the most competitive knowledge economy was one of the most important strategies, which influenced the policy in European Union especially on the regional level. It is also stressed that the convergence with EU strongest competitors in the era of globalisation requires the involvement of local and regional actors (government, research institutions, clusters of enterprises, innovative businesses, skilled work force) and restructuring the regions into knowledge economies [6].

The aim of this paper is twofold. The first is to examine the level of development of knowledge economy in Polish regions (Voivodships). In order to assess the advances in building the knowledge economy in region, the composite indicator for years 2003-2008 is constructed. The second purpose is to analyse the regional authorities' policies directed towards supporting the pillars underlying the knowledge economy.

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[4] Storper, M. (1997), *The Regional World: Territorial Development in a Global Economy*. New York: Guilford Press.

[5] Lissowska, M. (2007), The Challenge of the Knowledge-Based Economy: The Polish Case, *Gospodarka Narodowa*, 3/2007.

[6] European Commission, (2007), *Growing Regions, growing Europe, Fourth report on economic and social cohesion*, available at: http://ec.europa.eu/regional_policy/sources/docoffic/official/reports/cohesion4/index_en.htm (10.06.2012). The importance of building knowledge economy in the case of Poland was stressed in policy document such as National Strategic Reference Framework for 2017-2013, and the Regional Operational Programmes for the same period (RPOs are the part of NSRF).

The definition of the regions based on knowledge

Although the term knowledge-based economy is widely used, it does not a universal definition and, what is connected with that, the methods of measurement. In the narrow sense the knowledge economy is identified only with industries and services of high technology, which corresponds to the definition of F. Machlup's[7]" knowledge economy" (eg OECD defines knowledge-based economy, and is measured as a set of high-tech industries and sectors of skilled labor). This notion of knowledge-based economy is often met with criticism, pointing to the fact that the sectors considered low technology sectors can incorporate knowledge-intensive (K. Smith, for example, shows the intensity of the use of knowledge by the food processing sector, considered to be low technology industry[8]. In a broader sense the knowledge economy is conceived as a structure connecting subsystem of knowledge creation (eg laboratories) with a subsystem of knowledge using (formed by companies, hospitals, etc.)[9]. One of the institutions which uses a broader definition of KBE is the World Bank. This institution created the methodology KAM (Knowledge Assessment Methodology), according to which, knowledge-based economy is defined as: „ one that utilizes knowledge as the key engine of economic growth. It is an economy where knowledge is acquired, created, disseminated and used effectively to enhance economic development"[10]. It is based on four pillars, which constitute the Knowledge Economy framework[11]:

- An economic and institutional regime that provides incentives for the efficient use of existing and new knowledge and the flourishing of entrepreneurship.
- An educated and skilled population that can create, share, and use knowledge well.
- An efficient innovation system of firms, research centers, universities, think tanks, consultants, and other organizations that can tap into the growing stock of global knowledge, assimilate and adapt it to local needs, and create new technology.
- Information and Communication Technologies (ICT) that can facilitate the effective communication, dissemination, and processing of information.

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[7] Machlup, F. (1962), *The Production and Distribution of Knowledge in the United States*, NJ: Princeton University Press.
[8] Smith K., (2002), *What is the Knowledge Economy? Knowledge Intensity and Distributed Knowledge Bases*, Institute for New Technologies Discussion Paper 2002-6, The United Nations University, June.
[9] Cooke P., L. Leydesdorff (2006), Regional Development in the Knowledge-Based Economy: The Construction of Advantage. Introduction to the Special Issue., *Journal of Technology Transfer*, 31 (1), 2006, 5-15.
[10] Derek H. C. Chen and Carl J. Dahlman, (2005) *The Knowledge Economy, the KAM Methodology and World Bank Operations*, The World Bank Washington DC 20433, October 19.
[11] http://web.worldbank.org/WBSITE/EXTERNAL/WBI/WBIPROGRAMS/KFDLP/0,,contentMDK:20269026~menu%20PK:461205~pagePK:64156158~piPK:64152884~theSitePK:461198,00.html#Knowledge#Knowledge, World Bank: http://www.worldbank.org/, 05 June 2012.

The definition and methodology of the World Bank is a starting point for the methodology of assessing the level of development of regions based on knowledge in Poland in this paper. Three pillars of the knowledge economy in Polish Voivodeships (NUTS 2 units) will be analysed, namely: education and human capital, innovation system an information and communication system. In this analysis of the regions as knowledge-based economies it is assumed that the system of economic incentives and institutional regime, identified as one of the pillars of knowledge-based economy by the World Bank, is similar in all provinces, so it is not taken into account.[12]

The level of development of knowledge economy in Polish regions

This part of the paper will be devoted to the examination of the level of knowledge economy development of in Polish regions (Voivodeships). In order to assess the advances in building the knowledge economy in region, the composite indicator for years 2003-2008 is constructed.

The method of measuring the development of regional economies as knowledge economies in Poland is as follows:

1. Selection of variables describing the three pillars (components) of KBE in regions: education and human capital (E&HC) innovation system (IS) and information and communication system (ICT) in terms of content - formal.
2. Statistical analysis of variables describing the three pillars of the knowledge-based economy: the elimination of variables with low volatility and highly correlated, which allows for use in further analysis only those variables that hold the highest value information
3. Creation of sub-indices (indexes partial) for the three pillars of KBE (Hellwig standard method) and the overall index (ROW) as an arithmetic average of three sub-indices.

The first stage of this analysis is the selection of variables describing the knowledge economy. This choice depends on the definition of the knowledge economy. As already mentioned, in this paper to describe the KBE the methodology of World Bank is used. The choice of diagnostic variables must arise from a clear merit connection with the qualitative phenomenon, which is the subject of study. The selection of diagnostic variables requires their

[12] It would be of great importance and should be taken into account when comparisons is made with regions in other countries.

analysis in terms of content - formal, taking into account the generally accepted criteria, such as, according to A. Zeliaś[13]:

1. Universality - variables should have recognized the importance and significance.
2. Measurability - variables should be possible to measure directly or indirectly.
3. The availability of the figures - the possibility of collecting all figures.
4. Quality of data - whether data collection is not burdened with large random errors.
5. Economical - high cost of acquiring the data, should lead in the direction of minimizing the data set.
6. Possibility to interpret- condition for the selection of such variables that have a high substantive value, which means that they are consistent with the traditions of research and have clearly established interpretation.
7. The impact of variables - whether the variables are stimuli (a stimulatory function of the degree of development of the facility), or destimuli (inhibiting effect on the degree of development of the object)

In the table 1 the set of characteristic, which are proposed to be used for measuring the level of knowledge economy development is presented. All variables meet the above mentioned criteria. The cost of acquisition of variables describing the KBE for Voivodeships is relatively small (the criterion of economic efficiency), most of them are in fact published on the Central Statistical Office (CSO) website. These data are available for the years 2003-2008 (the criterion of availability), the most in absolute terms, but can easily be expressed as relative and real values, in order to eliminate the change of the money value in the period of time (the criterion of measurability). Most of them are stimulies, namely the higher value indicates a higher degree of development (only three variables are destimuli, marked with italics). You can also recognize that these are the data reliable, because CSO collects them based on international standards (mainly according to the recommendation of OECD and EUROSTAT, concluded in a series of textbooks called *Frascati Family Manuals*). They are also commonly used both in academic studies and in statistical studies created for various purposes (such as knowledge assessment methodologies of KAM or Australian Bureau of Statistics).

[13] Zeliaś A. (red.) (2000), *Taksonomiczna analiza przestrzennego zróżnicowania poziomu życia w Polsce w ujęciu dynamicznym.* Wydawnictwo AE, Kraków

Table 1. The characteristics describing the pillars of the knowledge economy in Polish regions

Education and Human Capital			
1	Students of high schools per 1000 people	13	Net education ratio for lower secondary schools
2	Graduates of high schools per 1000 people	14	6th Grade Achievements
3	Students of high technical schools per 1000 people	15	Gymnasium students achievement in Humanities
4	Graduates of high technical schools per 1000 people	16	Gymnasium students achievement in Math
5	Computer Science students per 1000 people	17	Achievements in maturity examination
6	Computer Science graduates per 1000 people	18	Life-long learning
7	Academic teachers per 1000 people	19	International migrations for permanent residence
8	Academic teachers of technical high schools per 1000 people	20	Intervoivodship migrations per 1000 people
9	Postgraduate students per 10 000 people	21	R&D Workers per 1000 of the Active Labor Force
10	Phd students per 10 000 people	22	*Unemployment Rate*
11	School graduates receiving certificate of secondary education per 1000 people	23	Labour Activity Rate
12	Net education ratio for primary schools	24	Share of population > 15, with tertiary education
Innovation system			
25	Higher education institutions (total)	34	Intramural expenditures on innovation activity per capita
26	Investments outlays per capita	35	The share of Industrial enterprises, which introduced innovation
27	Private investments outlays per capita	36	Average expenditures for one enterprise with innovation activity in thous. zl.(current prices)
28	Gross Capital per capita	37	Means for automating production processes in the industrial enterprises in units per 1 000 companies
29	Research-development activity number of units	38	Foreign capital per capita
30	Research-development activity, number of enterprises	39	Number of companies with foreign capital per 1000 people
31	Total Expenditure on R&D per capita	40	Inventions patent applications per 1 mln people
32	Total Expenditure for R&D as % of GDP	41	Inventions patents granted per 1 mln people
33	Total expenditures on innovation activity per capita		
ICT system			
42	Households with personal computers (as % of total)	50	*Pupils of lower secondary schools (gymnasium) per one computer*
43	Households with personal computers with access to internet(as a % of total)	51	Enterprises with Local Area Network (LAN)
44	Households with mobile phones (as a % of total)	52	Internet users (companies)
45	Telephones per 1,000 people	53	Intranet users (companies)
46	Cable television subscribers per 100 people	54	Share of companies with own www site
47	Percentage of primary schools equipped with computers	55	Share of enterprises using the Internet in dealing with the public
48	Percentage of lower secondary schools (gymnasium) equipped with computers	56	Share of enterprises receiving orders via computer networks
49	*Pupils of primary school per one computer*	57	Share of enterprises placing orders via computer networks

Source: own elaboration.

Selected real characteristics, describing the pillars of KBE in regions were subjected to statistical analysis. This analysis was performed in three steps. The first step was to calculate the coefficient of variation for variables. The purpose of this procedure was to eliminate variables with low levels of differentiation (so-called quasi-fixed variables). The coefficient of variation was calculated for each variable in the years 2003-2008, according to the formula:

Formula 1

$$CV = \frac{s}{\bar{x}}$$

where:
s – is the standard deviation of the population,
$\bar{x}$ - arithmetic mean of the features in a given year.

Table 2 presents the rejected variables. This leaves the variables for which the average coefficient of variation (arithmetic average for the years 2003-2008) was less than 0.1.

Table 2 Variables rejected (for which the average coefficient of variation is less than 0.1

Pillar	Variable	Variable symbol	The value of the mean coefficient of variation
E&HC	Net education ratio for primary schools	v12	1,43%
E&HC	Net education ratio for lower secondary schools	v13	1,63%
E&HC	6th Grade Achievements	v14	2,08%
E&HC	Gymnasium students achievement in Humanities	v15	3,21%
E&HC	Gymnasium students achievement in Math	v16	3,80%
E&HC	Achievements in maturity examination	v17	3,26%
E&HC	Labour Activity Rate	v23	3,63%
ICT	Households with personal computers (as % of total)	v42	9,53%
ICT	Households with mobile phones (as a % of total)	V44	6,86%
ICT	Percentage of primary schools equipped with computers	V47	6,05%
ICT	Percentage of lower secondary schools (gymnasium) equipped with computers	V48	4,66%
ICT	Pupils of lower secondary schools (gymnasium) per one computer	V50	8,81%
ICT	Enterprises with Local Area Network (LAN)	V51	7,76%
ICT	Internet users (companies)	V52	2,92%
ICT	Share of enterprises using the Internet in dealing with the public	V55	7,70%

Source: own elaboration

The variables characterizing the economic phenomenon as complex as the level of knowledge-based economy are closely linked in varying degrees, which means that they convey similar information. The task of the next step is to determine the diagnostic features to separate attributes, representatives for each group of variables (in the hearing: Education and human capital, innovation system and information and communication infrastructure). The set of all variables are divided into groups in such a way that[14]:

• in the same group of variables were used as carriers of similar information,

[14] Zeliaś op.cit, p. 41.

• in different groups of variables were used as carriers of various information.

The selection of variables representing the characteristics of each group based on the method of parametric Z. Hellwig[15] (Hellwig, 1981, Zeliaś 2000). After applying this method get called. clusters of variables that can be collections of multiple '(the variable central and at least one variable satellite) or jednoelementowymi (so-called variable insulated). The algorithm of this method can be described in the following steps:

1. A matrix of linear correlation coefficients R. between the variables of the group for voivodships.

Formula 2

$$R = \begin{bmatrix} 1 & r_{12} & \dots & r_{1k} \\ r_{21} & 1 & \dots & r_{2k} \\ \dots & \dots & \dots & \dots \\ r_{k1} & r_{k2} & \dots & 1 \end{bmatrix}$$

where:
r_{ij} means linear correlation coefficient between variable Vi and variable Vj (i, j = 1, …, k; i≠j).

2. The sum of the elements of each column j is calculated

Formula 3

$$R_j = \sum_{i=1}^{k} |r_{ij}|$$

3. A column ***s*** is identified, for which

Formula 4

$$R_s = \max_j (R_j)$$

4. From the column ***s*** elements r_{is} are selected, which satisfy the inequality:

Formula 5

$$|r_{is}| \geq r^*$$

where: r* is the threshold value of the correlation coefficient determined by the equation 6[16]:

[15] Hellwig *Z. (*1981)*: Wielowymiarowa analiza porównawcza i jej zastosowanie w badaniach wielocechowych obiektów gospodarczych,* (in:) W. Welfe, *Metody i modele ekonomiczno-matematyczne w doskonaleniu zarzadzania gospodarką socjalistyczną,* PWE, Warszawa. Zeliaś A. (red.) (2000), *Taksonomiczna analiza op.cit.*
[16] Nowak E. (1990), Problem informacji w modelowaniu ekonometrycznym, PWN, Warszawa, see Zeliaś A. (red.) (2000), *Taksonomiczna analiza przestrzennego zróżnicowania poziomu życia w Polsce w ujęciu dynamicznym.* Wydawnictwo AE, Kraków, p. 131

Formula 6

$$r^* = \min_i \max_j |r_{ij}|$$

Variable from the column ***s*** are considered to be the central variable, the variables for which the inequality exists are called satellite variables.

5. The reduction of the matrix R is made by a designated variable central and satellite variables (crossing out rows and columns).
6. The procedure described in steps 1-5 is repeated until exhaustion set of variables.

The following table shows the results of the calculations

Table 3. Designation of central and isolated variables for the three pillars of KBE

Pillar of KBE	Year	Value r*	Central variable	Satellite variables
Education and Human Capital (E&HL)	2003	0,44	V21, V5, V4	V11, V19, V22
	2004	0,44	V1, V5, V11	V19
	2005	0,49	V1, V5, V22	-
	2006	0,48	V1, V6, V22	-
	2007	0,30	V1, V11	V6
	2008	0,39	V1, V11	V6
Innovation System (SI)	2003	0,52	V29	V35, V37
	2004	0,44	V25, V37	-
	2005	0,50	V29, V37	-
	2006	0,41	V29	V35, V37
	2007	0,66	V30, V37	V39
	2008	0,39	V30	V35, V37
Information and Communication System (ICT)	2003	0,36	V56	V49, V53
	2004	0,36	V56	V53, V54
	2005	0,36	V56	V43, V53
	2006	0,57	V45	V43, V53, V54
	2007	0,44	V43	V53
	2008	0,65	V54, V49, V57	-

Source: own elaboration

In the last step has been taken into account the value of the coefficient of skewness. It was noted that the direction of the asymmetry factor was maintained throughout the period. Based on the coefficient of skewness is not decided on the elimination of any variable. Table 4 presents the 15 variables, which ultimately will be used to construct the index.

Table 4. The final list of diagnostic variables, used to construct the index

Variable symbol	**Variables representing the Education and Human Capital**
V 1	Students of high schools per 1000 people
V 5	Computer Science students per 1000 people
V 6	Computer Science graduates per 1000 people
V 11	School graduates receiving certificate of secondary education per 1000 people
V 19	International migrations for permanent residence

V 22	Unemployment Rate
	Variables representing the innovation system
V 29	Research-development activity number of units
V 30	Research-development activity, number of enterprises
V 35	The share of Industrial enterprises, which introduced innovation
V 37	Means for automating production processes in the industrial enterprises in units per 1 000 companies
	Variables representing the ICT system
V 43	Households with personal computers with access to internet(as a % of total)
V 49	Pupils of primary school per one computer
V 53	Intranet users (companies)
V 54	Share of companies with own www site
V 56	Share of enterprises receiving orders via computer networks

Source: own elaboration

The Hellwig method[17] is based on the creation of an abstract unit Po – called a model unit. It can be a real object (region), if characterised by the best values of all variables. This method can be shortly described by the following steps:

a) Variables are classified as stimuli and destimuli, there are two destimuli (*Unemployment rate* and *Pupils of primary school per one computer*).The destimuli were changed into stimuli in accordance with the formula:[18].

Formula7

$$z_i = 2\bar{x} - x_i$$

b) Standardization of variables (in order to eliminate the impact of the units of measurement) by the formula:

Formula 8

$$Z_{ik} = \frac{x_{ik} - \bar{x}_k}{S_k}$$

where:

Z_{ik} - standardized value of k features in the unit i

x_{ik} - absolute value of k features in the unit i

$\bar{x}_k$ - the arithmetic mean of the k features

[17] Hellwig, Z., 1968. Zastosowanie metody taksonomicznej do typologicznego podziału krajów ze względu na poziom ich rozwoju oraz zasoby i strukturę wykwalifikowanych kadr. *Przegląd Statystyczny,* nr 4, 307-326

[18] Kolenda M., *Taksonomia numeryczna. Klasyfikacja, porządkowanie danych, analiza obiektów wielocechowych,* Wydawnictwo Akademii Ekonomicznej we Wrocławiu, Wrocław 2006, p. 22

S_k - standard deviation of k feature

c) The model unit (Po) is created, an object with highest values for stimuli (in this case models for the three systems KBE).

Formula 9

$$Z_{ok} = \max Z_{ik}$$

d) The Euclideal distances between model unit (Po) and other objects (regions) are calculated

Formula 10

$$C_{io} = \sqrt{\sum_{k=1}^{k} (Z_{ik} - Z_{ok})^2} \qquad (i=1, 2, 3, \ldots, N)$$

where:

Z_{ik}, Z_{ok} – standardized value of k features in the unit i

e) The relative taxonomic development index is created, on the base of the formula:

Formula 11

$$D_i = 1 - \frac{c_{io}}{c_0} \qquad (i=1,2,3,\ldots,N)$$

where:

C_{io} Euclideal distances

$c_o = \bar{c} + 3S_o$:

$\bar{c}_o, S_o$ - arithmetic average, standard deviation in the sequence $\{c_{io}\}$ (i=1,2,3,…n):

$$\bar{c}_o = \frac{1}{N}\sum_{i-1}^{N} c_{io} \qquad S_o = \sqrt{\frac{1}{N}\sum_{i=1}^{N} (c_{io} - \bar{c}_o)^2}$$

This synthetic index of development Di takes the values from 0 to 1[19]. The closer the value of Di is to 1, the smaller the distance of the object from the model is and the higher level of development it has.

f) The creation of a synthetic index of the overall KBE in the regions as the arithmetic mean of three sub-indices pillars of KBE

The overall synthetic index of the knowledge economy in regions is calculated as the arithmetic average of three indices of knowledge economy pillars. It should be emphasized that the above calculations take into account the values of variables in all years together, so you can compare the growth rate during the time period.

[19] The probability for the value to be below zero is very small.

Table 5 presents the values of the overall index of KBE in regions, calculated as described in the previous paragraph for the Polish regions in the years 2003-2008. Regions are ranked according to the classification in 2008.

Table 5. The classification of the voivodships in 2008 (numbers in parentheses indicate the location of the region in a given year)

	KBE	2003	2004	2005	2006	2007	2008
1	MAZOWIECKIE	(1) 0,495	(1) 0,543	(1) 0,575	(1) 0,583	(1) 0,551	(1) 0,519
2	MAŁOPOLSKIE	(4) 0,338	(4) 0,389	(3) 0,464	(5) 0,433	(3) 0,458	(2) 0,420
3	DOLNOŚLĄSKIE	(5) 0,294	(6) 0,355	(5) 0,423	(3) 0,447	(4) 0,431	(3) 0,418
4	ŚLĄSKIE	(3) 0,361	(2) 0,441	(2) 0,509	(2) 0,455	(2) 0,464	(4) 0,415
5	ŁÓDZKIE	(2) 0,370	(3) 0,420	(4) 0,449	(4) 0,443	(5) 0,423	(5) 0,381
6	WIELKOPOLSKIE	(12) 0,264	(8) 0,337	(8) 0,397	(7) 0,383	(8) 0,365	(6) 0,365
7	POMORSKIE	(8) 0,283	(10) 0,325	(9) 0,369	(9) 0,369	(7) 0,366	(7) 0,344
8	PODKARPACKIE	(7) 0,291	(7) 0,348	(6) 0,413	(8) 0,370	(6) 0,379	(8) 0,339
9	PODLASKIE	(6) 0,294	(5) 0,371	(7) 0,406	(6) 0,389	(9) 0,346	(9) 0,316
10	KUJAWSKO-POMORSKIE	(13) 0,261	(13) 0,285	(16) 0,324	(15) 0,300	(10) 0,342	(10) 0,274
11	OPOLSKIE	(16) 0,193	(15) 0,272	(14) 0,341	(16) 0,289	(12) 0,298	(11) 0,271
12	LUBELSKIE	(14) 0,243	(14) 0,278	(13) 0,343	(11) 0,324	(11) 0,303	(12) 0,249
13	ZACHODNIOPOMORSKIE	(11) 0,269	(9) 0,327	(12) 0,346	(12) 0,324	(15) 0,284	(13) 0,245
14	WARMIŃSKO-MAZURSKIE	(10) 0,271	(11) 0,304	(11) 0,352	(10) 0,325	(14) 0,292	(14) 0,239
15	ŚWIĘTOKRZYSKIE	(15) 0,228	(16) 0,262	(15) 0,325	(14) 0,315	(16) 0,266	(15) 0,236
16	LUBUSKIE	(9) 0,276	(12) 0,295	(10) 0,354	(13) 0,319	(13) 0,294	(16) 0,217

Source: own elaboration

The best results in the transformation into knowledge-based regions, throughout the period, reaches Mazowieckie voivodship. The second position in 2008 is occupied by the Małopolskie, which throughout the whole period occupied high positions in the ranking (lowest fifth),the similar description can be applied to Dolnośląskie (Lower Silesia), occupying the third position (lowest 6th position).

The policies to develop knowledge economy in Polish regions

In this part of the paper the regional authorities' policies directed towards supporting the pillars underlying the knowledge economy will be presented. As it was mentioned in the introduction it is commonly agreed that the government should involve in promoting the development of the knowledge economy due to several market failures. This idea proclaimed by the economist[20] is realised by politicians through various policies on different economic

[20] G. Seravalli (2009), *Competitive European regions through research and innovwtion. Different theoretical approaches to innovation policies,* Report Working Paper, January., Bachtler, D. Yuill (2001), *Policies and*

levels. The policy objective to support the development of the knowledge-based economy by increasing investment in science, research and development, innovation, or education, or infrastructure supporting the flow of knowledge (codified) and information is one of the most important objectives in most of the countries or communities of countries. At the level of European Union policy the Lisbon Strategy (LS), which indicated the goal of creating "the most competitive and dynamic knowledge-based economy by 2010 "was the most influential one. Also in the renewed Lisbon Strategy, whose main objective is growth and employment, the priority activities include the promotion of knowledge, innovation and human capital. LS assumptions are reflected in EU policy-making at various levels at the current programming period 2007-2013. The use of the funds of the regional policy (which accounts to one-third of the EU budget - around 350 billion Euro of funds in the 2007-2012 programming period) is also largely focused on the objectives of the renewed Lisbon Strategy, including support for the knowledge economy in a broad sense. In December 2005 the Council decided that some of the funds allocated to the cohesion policy programs was reserved for investments related to the objectives of the renewed Lisbon Strategy, in particular for research, innovation, information society, human capital and business development (specifically: 60% for less-developed regions and 75 % for the other regions, 1083/2006, p 25). Countries that joined the EU on 1 May 2004 and after that date are not required to fulfil these requirements but most of them dedicated considerable amount of funds on these issues.

In this paper only funds of intraregional policy in Poland will be discussed. Regional operational programs are designed and managed by the executive provinces. They represent a kind of bridge between the development strategies of regions and the objectives of cohesion policy as outlined in the national and EU level. Due to the volume of funds involved, the regional operational programs can be regarded as the most important policy instrument intraregional in Poland. The funds of regional component of the Human Capital Operational Programme can also be perceived as such an instrument.

One of the most important documents identifying the strategic priorities of the country and the implementation of cohesion policy are the National Strategic Reference Framework (NSRF). Each member country was obliged to o prepare such a document, based on Community Strategic Guidelines, (this follows from Council Regulation No 1083/2006 of 11 July 2006). To support the realisation of the objectives of cohesion policy (Convergence and

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strategies in regional development: a shift in paradigm? "Regional and Industrial Policy Research Paper", 46, p.12

European Territorial Cooperation) in Poland the sum of 67 billion Euro[21] was envisaged in the NSRF from the European Regional Development Fund (ERDF) (52%), European Social Fund (ESF) (15%) and the Cohesion Fund (CF) (33%). These amounts do not include national funds (estimated at 11.9 billion Euro) and private (estimated at 6.4 billion euros). From the table below, you can read a breakdown of the NSRF to specific operational programs. Biggest part is to be allocated to the Infrastructure and Environment (42%). The second portion of funds will be allocated to support the realisation of 16 regional operational programs (discussed in this section). The support provided for the human capital accounts to 15% of funds and for innovation - 12%. Poland's NSRF includes a significant commitment to the Lisbon Strategy for jobs and growth (64% directly to elements of the Lisbon Strategy).

Table 6 The breakdown of National Strategic Reference Framework funds in Poland

OP	Community contribution		"earmarking" in %	
	Total	% of funds	Lisbon earmarking	
OP Innovative Economy	8 254 885 280	12%	7 831 882 929	95%
OP Human capital	9 707 176 000	15%	8 036 029 819	83%
OP Infrastructure and Environment	27 913 683 774	42%	18 616 256 995	83%
OP Development of Eastern Poland	2 273 793 750	3%	1 000 013 523	44%
16 Regional OPs	16 555 614 188	25%	7 026 917 404	42%
NSRF	66 553 157 091	100%	42 511 100 670	63.9%

Source: European Union Regional Policy (2008), *Cohesion Policy 2007-13 National Strategic Reference Frameworks*, p. 58, available at: http://ec.europa.eu/regional_policy/atlas2007/fiche/nsrf.pdf (15th of June 2012)

In the further analysis of intreregional policy and its support to develop knowledge based economy, the following assumptions should be made:

• intrategional policy is characterized by the spending of EU funds and supported within the general framework of regional operational programs and the regional component of the operational program Human Capital;

• policy - related data based on the indicative breakdown of funds from the EU budget (which does not include the national share), suggested that subjective measures are related to building a knowledge-based economy;

• it is assumed that policy characterized in this way is an independent policy of regional government (of the Voivodeships) in compliance with regional development strategies. It should be remembered in this place about many restrictions on local government decisions arising from the EU and national planning procedures and disbursement of EU funds (the guidelines of the capacities of each disbursement of funds, the guidelines of the Minister to

[21] Poland was the largest beneficiary of Cohesion policy for this period

prepare a regional operational programs, the impact of government on the shape of the regional component of OP HC, and others).

The analysis of relationship between the indices characterizing knowledge-based economy and the following indicators related to public expenditure:

• expenses related to the promotion of knowledge-based economy, as per 1 inhabitant;

• the share of expenditure to support knowledge-based economy (by components) in total expenditure intraregional policy.

was carried out.

It occurred to be quite a difficult task to separate expenditures on support for knowledge-based economy from total expenditures. The procedure adopted was similar to that of specifying the "Lisbon" expenditure in politics. The category of intervenes defined in COMMISSION REGULATION (EC) No 1828/2006 was a starting point. Although the Lisbon expenses often are associated with the promotion of knowledge-based economy, not all were taken into further analysis, only those that are designed to support the three pillars of the knowledge-based economy, in accordance with the knowledge economy definition used in this paper. The proposal to assign a category to the pillars of knowledge-based economy is as follows:

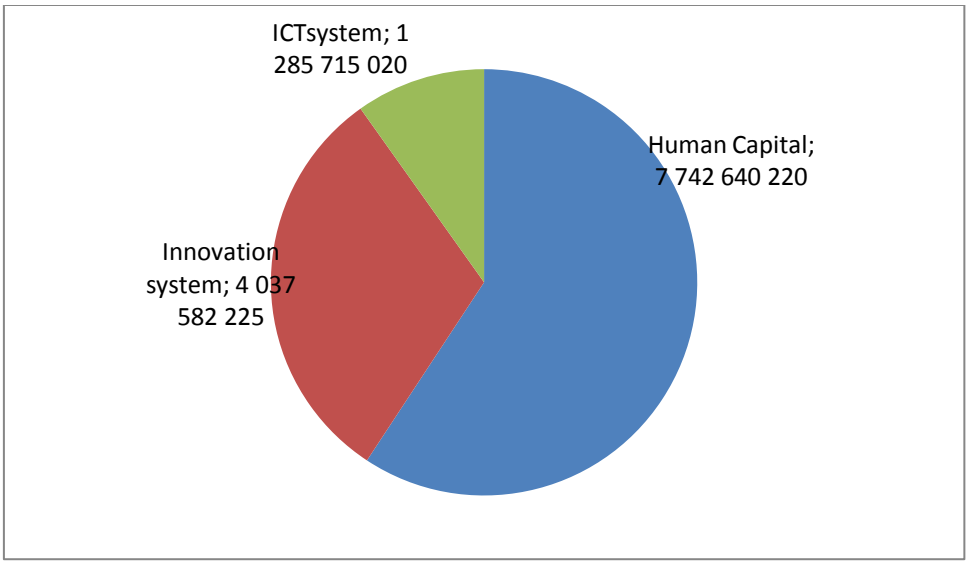
Education and human capital: 62, 63, 64, 65, 66, 67, 67, 68, 69, 70, 71, 72, 73, 74, 75

Innovation system: 1, 2, 3, 4, 5, 6, 7, 8, 9, 80

ICT system: 10, 11, 12, 13, 14, 15

Figure 1 shows the share of intraregional policy expenditures directed to three pillars of KBE. 59 % of the total sum is dedicated to the support of Education and human capital. 31% is planned to the innovation system support and the rest (10%) will be spent on fostering ICT system. In the table 7 the division of funds in Voivodeships is presented.

Figure 1The division of intraregional policy means on three pillars of knowledge based economy



Source: own elaboration.

Table 7 The expenditures on the pillars of the knowledge based economy in each Voivodeship (in EUR)

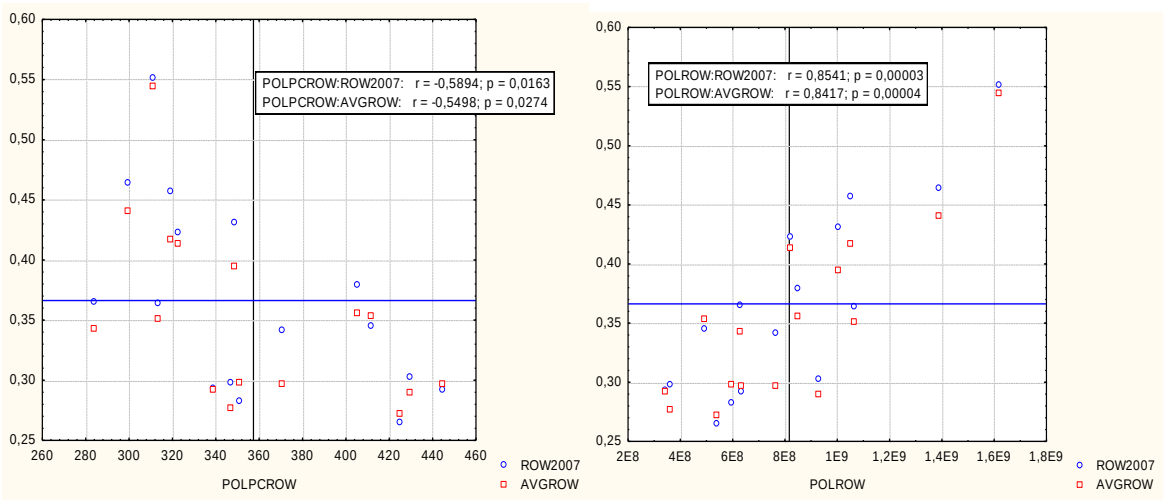
Voivodeship	E&HC		IS		ICT		Total
DOLNOŚLĄSKIE	572 709 558	57%	308 454 516	31%	120 050 314	12%	1 001 214 388
KUJAWSKO-POMORSKIE	451 715 328	59%	255 992 827	33%	57 060 229	7%	764 768 384
LUBELSKIE	562 942 528	61%	291 273 653	31%	72 441 739	8%	926 657 920
LUBUSKIE	209 613 286	61%	94 630 216	28%	37 320 713	11%	341 564 215
ŁÓDZKIE	529 287 139	65%	220 754 009	27%	70 446 664	9%	820 487 812
MAŁOPOLSKIE	648 141 682	62%	324 478 129	31%	75 032 884	7%	1 047 652 695
MAZOWIECKIE	974 249 455	60%	439 409 605	27%	205 127 627	13%	1 618 786 687
OPOLSKIE	189 690 378	53%	142 516 494	40%	25 628 689	7%	357 835 561
PODKARPACKIE	488 925 646	58%	266 116 324	31%	94 804 434	11%	849 846 404
PODLASKIE	275 816 596	56%	162 910 358	33%	50 896 631	10%	489 623 585
POMORSKIE	398 768 436	63%	189 592 806	30%	40 270 492	6%	628 631 734
ŚLĄSKIE	802 788 173	58%	384 038 005	28%	200 867 100	14%	1 387 693 278
ŚWIĘTOKRZYSKIE	326 338 069	60%	184 609 295	34%	29 025 782	5%	539 973 146
WARMIŃSKO-MAZURSKIE	332 964 090	53%	238 273 077	38%	62 192 522	10%	633 429 689
WIELKOPOLSKIE	662 718 276	62%	298 735 106	28%	102 549 200	10%	1 064 002 582
ZACHODNIOPOMORSKIE	315 971 582	53%	235 797 803	40%	42 000 000	7%	593 769 385
SUME	7 742 640 220	59%	4 037 582 225	31%	1 285 715 020	10%	13 065 937 465

Source: own elaboration.

Figure 2 illustrates the relationship between the level of development of knowledge-based economy (the index for 2007 and the average for the years 2003-2008), and expenditure of intraregional policies to support the development. The left diagram shows a reference to expenditure per capita, while the right-hand reference to the total expenditure. For ease of reading results indicated the average index for 2007 and the average (arithmetic mean) for expenditure, they share all the charts into four quadrants. In accordance with the accepted

interpretation of expenditure on KBE, state decided to allocate in the years 2007-2013 an average of about 816 million Euro to support the pillars of the knowledge-based economy (about 360 Euro per capita). Province, which have a higher rate of GDP in general allocate more funds for this purpose (positive, statistically significant linear correlation coefficient). Most of the funds were allocated by Mazowieckie Voivodeship - more than 1.6 billion. Euro (the largest recipient of funds), the least sum by Lubuskie and Opolskie (respectively 342 and 348 million. Euro). In case of per capita expenditures and the level of KBE development the relationship is rather the opposite (negative, statistically significant relationship). The lowest spendings are in in the region of Pomorskie and Śląskie (less than 300 Euro), most is spent on this goal in Warmińko – Mazurskie (more than 440 Euro).

Figure 2 The relationship between the level of KBE development and expenditures to support the pillars of the KBE



Conclusions

References